WEBVTT

1
00:00:00.000 --> 00:00:01.500
And you guys are just right on time.

2
00:00:02.835 --> 00:00:06.525
Okay? So, so we're 10 minutes ahead,

3
00:00:06.755 --> 00:00:08.565
doesn't mean the speakers get any more time.

4
00:00:08.665 --> 00:00:10.485
So the speakers are still on 25 minutes.

5
00:00:11.145 --> 00:00:13.845
So we've got a schedule four

6
00:00:14.135 --> 00:00:16.525
after the coffee break, we've got two more presentations.

7
00:00:16.925 --> 00:00:18.525
There'll be a panel discussion.

8
00:00:19.105 --> 00:00:23.285
Uh, at the end of that we're gonna do, uh, the buffet

9
00:00:24.175 --> 00:00:25.285
lunch in this room.

10
00:00:26.105 --> 00:00:29.165
And so once the panel discussion's over

11
00:00:29.225 --> 00:00:31.845
and when the food's set up, it's kind of imperative

12
00:00:31.875 --> 00:00:34.725
that you go get through the line as quick as you can so

13
00:00:34.725 --> 00:00:36.765
that we can start the, uh, lunch

14
00:00:36.825 --> 00:00:38.845
and learn with Edison Tower.

15
00:00:38.985 --> 00:00:40.685
So let Edison go first, please,

16
00:00:40.785 --> 00:00:42.565
and then get through as quick as you can.

17
00:00:42.625 --> 00:00:45.765
Sit down and as soon as the buffet line has died down,

18
00:00:45.765 --> 00:00:46.845
we'll start the lunch and learn.

19
00:00:47.635 --> 00:00:49.205
Okay, so the presentation

20
00:00:49.535 --> 00:00:53.485
after the coffee break is a FCS single engine approach

21
00:00:53.995 --> 00:00:58.045
test safety improvement by, uh, our forensic Gulfstream.

22
00:00:58.785 --> 00:01:03.525
So we have, uh, TJ Lawrence and Tobias Van Selten.

23
00:01:04.305 --> 00:01:06.325
TJ is a flight test engineer at Gulfstream,

24
00:01:06.365 --> 00:01:08.485
specializing in developing certification

25
00:01:08.545 --> 00:01:10.005
of various avionic systems

26
00:01:10.005 --> 00:01:12.645
with a focus on automatic flight control systems.

27
00:01:13.385 --> 00:01:17.045

His flight test career spans four type certification

28
00:01:17.045 --> 00:01:19.165
projects, numerous STC activities.

29
00:01:19.695 --> 00:01:23.285
Prior to joining flight test organization at uh, Gulfstream,

30
00:01:23.345 --> 00:01:26.445
he supported G six 50 manufacturing operations

31
00:01:26.465 --> 00:01:27.885
as a manufacturing engineer,

32
00:01:28.445 --> 00:01:29.845
a graduate of Purdue University.

33
00:01:29.945 --> 00:01:32.925
He holds a degree in aeronautical engineering technology

34
00:01:33.705 --> 00:01:35.725
and committed to being a well-run engineer.

35
00:01:35.725 --> 00:01:39.125
He possesses both his a and p and private pilot certificate.

36
00:01:39.185 --> 00:01:42.605
So the a and p is a tough, uh, a tough road

37
00:01:42.665 --> 00:01:44.485
to go down while you're going to school.

38
00:01:44.585 --> 00:01:45.645
So congrats on that.

39
00:01:46.025 --> 00:01:47.765
Uh, I know a lot of a and p mechanics

40
00:01:47.765 --> 00:01:49.245
and I value a lot of their input.

41
00:01:49.385 --> 00:01:51.125
Uh, Tobias friend of mine

42
00:01:51.145 --> 00:01:53.245
who serves on the manufacturer's flight test council

43
00:01:53.385 --> 00:01:54.645
and represents Gulfstream,

44
00:01:54.645 --> 00:01:56.845
whereas I represent Gulf, uh, Bombardier.

45
00:01:56.905 --> 00:02:00.485
But, uh, great work on that committee working there.

46
00:02:00.745 --> 00:02:03.405
Uh, Tobias is a 20 year Marine Corps veteran,

47
00:02:03.555 --> 00:02:05.605
flew helicopters, then f eighteens.

48
00:02:06.745 --> 00:02:11.165
Uh, and then once he's out of his, uh, naval career, went

49
00:02:11.285 --> 00:02:12.805
to work at Gulfstream as a test pilot.

50
00:02:12.945 --> 00:02:17.605
And then from the G 500 to the G 800, he's held positions

51
00:02:17.605 --> 00:02:20.365
as test pilot, director of flight test engineering,

52
00:02:20.505 --> 00:02:22.005
and director of development tests.

53
00:02:22.185 --> 00:02:25.405
So next up will be their presentation on the, uh,

54
00:02:25.405 --> 00:02:28.645

single engine A FCS test improvements come on up guys.

55
00:02:28.715 --> 00:02:29.885
Looking forward to it.

56
00:02:36.745 --> 00:02:38.245
Now it's funny, the coffee break,

57
00:02:38.245 --> 00:02:40.005
Dave said we had an extra 10 minutes, so not

58
00:02:40.005 --> 00:02:42.645
to worry about the time, but, uh, thanks.

59
00:02:43.705 --> 00:02:45.885
Um, wanted to thank the flight test safety committee for,

60
00:02:45.905 --> 00:02:47.365
uh, letting us come and talk to you guys today

61
00:02:47.465 --> 00:02:49.085
and for giving us a coveted spot.

62
00:02:49.095 --> 00:02:50.725
We've all gone to the bathroom. We're freshly

63
00:02:50.725 --> 00:02:53.205
caffeinated, you know, mid-morning.

64
00:02:53.265 --> 00:02:56.205
So, uh, here we are to talk to you about, uh,

65
00:02:56.275 --> 00:03:00.445
some safety improvements we made during, uh, a FCS, uh,

66
00:03:00.445 --> 00:03:03.005
single engine approach testing during our G 800 program.

67
00:03:03.785 --> 00:03:05.605
Before we jump into the details, kinda like

68
00:03:05.605 --> 00:03:07.085
to give you a little overview of

69
00:03:07.085 --> 00:03:08.685
what we've been doing at Gulfstream flight tests

70
00:03:08.705 --> 00:03:09.805
for the last 10 years.

71
00:03:10.385 --> 00:03:12.245
On the screen, uh, kind of a marketing slide,

72
00:03:12.285 --> 00:03:14.245
a six aircraft, which currently represent

73
00:03:14.245 --> 00:03:15.525
what we have in production

74
00:03:15.825 --> 00:03:18.365
and in test, primarily like to focus.

75
00:03:18.365 --> 00:03:21.565
Going back about 10 years in the 2015

76
00:03:21.625 --> 00:03:26.005
to 2019 timeframe, we developed, uh, the G seven family

77
00:03:26.185 --> 00:03:29.485
for the first two members of it in the G 500 in the G 600.

78
00:03:30.305 --> 00:03:31.805
And this was the first clean sheet design

79
00:03:32.225 --> 00:03:33.485
for Gulfstream in about 20 years.

80
00:03:34.065 --> 00:03:36.605
And so incorporated, uh, a lot of work

81
00:03:36.905 --> 00:03:39.605

and, um, kept us pretty busy for four years.

82
00:03:39.915 --> 00:03:43.125
Shortly thereafter, from 2020 till just last month,

83
00:03:43.505 --> 00:03:44.645
we developed the G 800

84
00:03:44.745 --> 00:03:48.005
and the G 700, which was designed to replace our legacy,

85
00:03:49.735 --> 00:03:53.315
um, six 50, uh, flagship aircraft.

86
00:03:53.655 --> 00:03:55.275
And it's in the G 800

87
00:03:55.275 --> 00:03:57.115
and G 700 program where we kind

88
00:03:57.115 --> 00:03:58.915
of had our A FCS flight test improvement

89
00:03:58.985 --> 00:04:00.195
that we're gonna talk about today.

90
00:04:00.735 --> 00:04:03.235
So for those of you that may not be super familiar

91
00:04:03.985 --> 00:04:06.315
with the way most companies do stuff in, uh,

92
00:04:06.315 --> 00:04:08.475
part 25 testing, wanted to give you a little bit

93
00:04:08.475 --> 00:04:09.755
of an overview 'cause it's applicable to

94
00:04:09.755 --> 00:04:10.875
what we're gonna talk about here in a minute.

95
00:04:11.175 --> 00:04:13.355
So we kind of break things down into three phases

96
00:04:13.355 --> 00:04:15.235
of testing development company

97
00:04:15.235 --> 00:04:16.275
and certification testing

98
00:04:16.585 --> 00:04:18.435
development's, kind of just what it sounds like.

99
00:04:18.825 --> 00:04:20.115
It's where at flight test we get

100
00:04:20.115 --> 00:04:22.035
that system under test for the first time.

101
00:04:22.375 --> 00:04:24.435
And, uh, we begin to determine what level

102
00:04:24.435 --> 00:04:25.595
of system maturity we have.

103
00:04:25.905 --> 00:04:29.875
It's where we'll do five flicks fly type of process,

104
00:04:30.815 --> 00:04:32.755
and where we also develop our test process.

105
00:04:33.095 --> 00:04:34.995
So hopefully at the end of the developmental phase,

106
00:04:35.325 --> 00:04:38.155
we've got a system that's ready for, uh, certification

107
00:04:38.415 --> 00:04:40.795
and we've got a test process that's ready for certification.

108
00:04:41.185 --> 00:04:43.195

Company testing is kind of that dry run

109
00:04:43.195 --> 00:04:45.995
for certification we're executing with a cert candidate,

110
00:04:46.195 --> 00:04:48.635
hardware and software, and we're executing out

111
00:04:48.635 --> 00:04:51.155
of the certification test, uh, plan.

112
00:04:51.855 --> 00:04:54.275
And then certification is where we invite the FAA in

113
00:04:54.275 --> 00:04:56.395
and we find compliance to part 25.

114
00:04:57.255 --> 00:04:59.555
The schedule you see at the bottom there is, uh,

115
00:04:59.855 --> 00:05:01.915
the G 800 schedule for 2024.

116
00:05:03.135 --> 00:05:06.115
And you can see that for a FCS testing, we had three blocks.

117
00:05:06.655 --> 00:05:08.475
You'll note that the development block there

118
00:05:09.015 --> 00:05:11.115
and the January timeframe is relatively short.

119
00:05:11.175 --> 00:05:13.155
We didn't really plan any software updates there

120
00:05:13.155 --> 00:05:14.435
as this was a derivative aircraft.

121
00:05:14.815 --> 00:05:16.675
And then from development quickly into company

122
00:05:17.215 --> 00:05:18.475
and the delay between company

123
00:05:18.475 --> 00:05:20.355
and certification is really to allow us

124
00:05:20.355 --> 00:05:22.555
and the test team to write the company flight test report,

125
00:05:22.855 --> 00:05:24.235
get it approved by the FAA,

126
00:05:24.285 --> 00:05:26.235
which is essentially our entry criteria

127
00:05:26.735 --> 00:05:27.875
for certification test.

128
00:05:28.655 --> 00:05:29.555
So now a little bit more about

129
00:05:29.555 --> 00:05:30.475
what we're gonna talk about today.

130
00:05:30.475 --> 00:05:31.875
So a FCS testing, what is it?

131
00:05:31.875 --> 00:05:33.435
Automatic flight control testing.

132
00:05:33.825 --> 00:05:35.115
It's essentially we're going out

133
00:05:35.115 --> 00:05:37.715
and evaluating the performance of the flight director,

134
00:05:37.895 --> 00:05:40.915
the autopilot and the auto throttle in all phases of flight.

135
00:05:41.415 --> 00:05:43.675

The, uh, guidance panel you see at the upper right hand

136
00:05:43.675 --> 00:05:45.435
corner is the primary interface.

137
00:05:45.435 --> 00:05:48.315
This is outta the G 800 primary interface between the, uh,

138
00:05:48.315 --> 00:05:49.995
pilot and the A FCS.

139
00:05:50.495 --> 00:05:52.115
The scope of this testing's rather big.

140
00:05:52.295 --> 00:05:54.275
We do about 400 test points,

141
00:05:54.445 --> 00:05:56.075
which takes us about 20 flights.

142
00:05:56.375 --> 00:05:57.965
And we plan, as you saw on that calendar,

143
00:05:58.415 --> 00:05:59.805
about a month for each phase.

144
00:06:00.105 --> 00:06:03.005
So it's a pretty significant, uh, phase of testing

145
00:06:03.675 --> 00:06:06.245
test point we're gonna talk about today is a single engine

146
00:06:06.245 --> 00:06:07.965
precision approach with go around.

147
00:06:08.665 --> 00:06:10.645
So what are we primarily evaluating on

148
00:06:10.645 --> 00:06:13.725
that we're evaluating the A C's ability to capture

149
00:06:13.865 --> 00:06:16.325
and track the approach safely, guide us

150
00:06:16.325 --> 00:06:19.045
to a decision altitude, initiate a go around,

151
00:06:19.475 --> 00:06:22.285
look at the transition between the approach mode to the go

152
00:06:22.285 --> 00:06:24.485
around mode for the single engine approach.

153
00:06:24.555 --> 00:06:26.565
Make sure that the A FCS can safely handle

154
00:06:26.995 --> 00:06:29.245
that single engine go around and then capture

155
00:06:29.265 --> 00:06:30.485
and track the missed approach guidance.

156
00:06:30.705 --> 00:06:32.405
So that's really what we're looking at during the approach.

157
00:06:33.425 --> 00:06:34.685
So as we got into the seven

158
00:06:34.705 --> 00:06:38.365
and 800 program, we made some improvements to our system,

159
00:06:38.455 --> 00:06:43.085
which drove some, uh, scope increase for this testing.

160
00:06:43.475 --> 00:06:45.445
Essentially what we did was we made some, uh,

161
00:06:45.445 --> 00:06:46.885
flight control system improvements

162
00:06:47.305 --> 00:06:50.925

to remove some existing a FM limitations we had on the 500

163
00:06:50.925 --> 00:06:53.765
and 600, which restricted auto throttle use

164
00:06:53.765 --> 00:06:54.885
during single engine approach

165
00:06:55.345 --> 00:06:57.445
and restricted the autopilot use on single

166
00:06:57.445 --> 00:06:58.805
engine go arounds.

167
00:06:59.105 --> 00:07:01.245
So this was an important safety improvement we wanted

168
00:07:01.245 --> 00:07:02.805
to make for our new, uh, flagship program.

169
00:07:03.585 --> 00:07:04.925
So in doing that, we realized

170
00:07:05.105 --> 00:07:07.045
as the test team got into the weeds that hey,

171
00:07:07.045 --> 00:07:10.165
our test scope had increased when we did this testing in the

172
00:07:10.165 --> 00:07:13.565
500 600 program, we're able to accomplish the objectives

173
00:07:13.795 --> 00:07:15.885
with just one single engine approach to go around.

174
00:07:16.465 --> 00:07:18.485
Now that we've gotten into the 700 and 800

175
00:07:18.865 --> 00:07:21.805
and needed to more thoroughly evaluate the system, we needed

176
00:07:21.805 --> 00:07:23.485
to do four single engine approaches.

177
00:07:24.105 --> 00:07:26.685
So the result is, is that for each phase of testing,

178
00:07:27.145 --> 00:07:30.525
we end up in the low altitude single engine configuration

179
00:07:30.945 --> 00:07:32.005
for somewhere between 40

180
00:07:32.005 --> 00:07:33.885
and 60 minutes, depending on our efficiency.

181
00:07:34.425 --> 00:07:35.725
So this is kind of where we were at the

182
00:07:35.725 --> 00:07:36.765
beginning of 700 testing.

183
00:07:40.945 --> 00:07:42.005
All right, well you can't have a,

184
00:07:42.005 --> 00:07:43.765
a safety presentation without a hazard analysis.

185
00:07:43.785 --> 00:07:46.005
So let's walk through one for the single engine approach

186
00:07:46.005 --> 00:07:48.245
and go around testing that took bias just introduced.

187
00:07:48.745 --> 00:07:50.405
Uh, one of the hazards that we identified

188
00:07:50.405 --> 00:07:52.805
for this testing was a low altitude, total loss of thrust,

189
00:07:53.305 --> 00:07:55.125

uh, that would occur if we had a failure

190
00:07:55.225 --> 00:07:56.565
of our only operating engine.

191
00:07:56.905 --> 00:07:58.725
We think that would most likely be due to a bird strike,

192
00:07:59.025 --> 00:08:00.885
but it could really be due to any of the items listed there

193
00:08:00.885 --> 00:08:01.965
or any that we didn't even think of.

194
00:08:02.665 --> 00:08:06.165
Uh, if we encounter that to hazard, uh, good opportunity,

195
00:08:06.165 --> 00:08:08.125
good chance, we're gonna, uh, have an off report,

196
00:08:08.185 --> 00:08:09.605
off airport landing or crash.

197
00:08:10.425 --> 00:08:13.565
We identified the probability of that cause as being remote

198
00:08:14.025 --> 00:08:16.245
and the severity of encountering that hazard

199
00:08:16.745 --> 00:08:19.325
as catastrophic, meaning if we have an off airport landing,

200
00:08:19.355 --> 00:08:21.005
there's a good chance there's gonna be a loss of life.

201
00:08:22.225 --> 00:08:24.005
So with our, uh, severity of catastrophic

202
00:08:24.385 --> 00:08:25.565
and our probability of remote,

203
00:08:25.645 --> 00:08:27.725
that puts us in the medium risk section of our risk matrix.

204
00:08:29.335 --> 00:08:30.805
Let's, uh, quickly go through some

205
00:08:30.805 --> 00:08:32.045
of the traditional preventive actions

206
00:08:32.045 --> 00:08:33.085
and minimization procedures

207
00:08:33.085 --> 00:08:34.565
that we've utilized for this testing in the past.

208
00:08:34.915 --> 00:08:36.685
This can kind be broken down into three areas.

209
00:08:37.025 --> 00:08:39.045
Uh, first we try to prevent the hazard of total loss

210
00:08:39.045 --> 00:08:40.245
of thrust from occurring in the first place.

211
00:08:40.745 --> 00:08:42.645
Uh, we do that by not testing with known fuel

212
00:08:42.945 --> 00:08:45.125
or engine issues, and we monitor

213
00:08:45.125 --> 00:08:46.445
bird activity to make sure it's low.

214
00:08:46.665 --> 00:08:48.005
But besides those simple items,

215
00:08:48.345 --> 00:08:49.525
uh, this is kind of outta our control.

216
00:08:49.525 --> 00:08:51.525

We have very limited, uh, control over this.

217
00:08:51.995 --> 00:08:53.445
Next, we try to reduce the severity

218
00:08:53.505 --> 00:08:55.925
of the off airport landing if it it were to be encountered.

219
00:08:56.105 --> 00:08:58.125
Uh, all the mitigations, uh, that you see listed

220
00:08:58.185 --> 00:09:00.405
or minimizations that you see listed there, um,

221
00:09:00.405 --> 00:09:02.965
really the intent of all those is to make it so

222
00:09:02.965 --> 00:09:04.685
that we increase the odds of the crew surviving

223
00:09:04.685 --> 00:09:05.725
that event if it occurs.

224
00:09:06.945 --> 00:09:08.765
Lastly, we try to prevent, uh,

225
00:09:08.785 --> 00:09:11.085
the effect from occurring if we encounter the hazard.

226
00:09:11.505 --> 00:09:12.885
So we do that by having the fastest

227
00:09:13.025 --> 00:09:14.445
engine restart time possible.

228
00:09:14.785 --> 00:09:17.965
And we achieve that by having the A PU already operating

229
00:09:18.185 --> 00:09:20.245
to supply air to restart the engine

230
00:09:20.245 --> 00:09:21.725
that we previously intentionally shut down.

231
00:09:22.265 --> 00:09:23.645
Uh, with the pilot monitoring has

232
00:09:23.645 --> 00:09:25.645
that restart flow practiced and memorized,

233
00:09:25.945 --> 00:09:28.365
and the cockpit is set up to have the, the minimum amount

234
00:09:28.365 --> 00:09:30.605
of button presses needed to get that engine restarted.

235
00:09:31.985 --> 00:09:34.205
All right, so let's walk through a potential scenario here.

236
00:09:34.545 --> 00:09:35.885
Uh, right now, uh,

237
00:09:35.885 --> 00:09:37.525
you're looking down runway seven at

238
00:09:37.525 --> 00:09:38.805
Brunswick Golden Niles Airport.

239
00:09:39.065 --> 00:09:40.405
Uh, you're looking out the front windshield

240
00:09:40.405 --> 00:09:42.045
of the aircraft from an instrumentation camera

241
00:09:42.045 --> 00:09:43.245
that we have on board.

242
00:09:43.745 --> 00:09:45.565
And, uh, this is an airport in southeast Georgia

243
00:09:45.565 --> 00:09:48.085

that we like to utilize a lot for our testing, uh, mainly

244
00:09:48.245 --> 00:09:49.605
'cause of its post close proximity

245
00:09:49.605 --> 00:09:50.925
to our home base of Savannah.

246
00:09:51.425 --> 00:09:53.245
Uh, but more importantly, more importantly,

247
00:09:53.245 --> 00:09:54.245
for single engine testing.

248
00:09:54.625 --> 00:09:57.925
Uh, we like this airport, excuse me, due to, as you can see,

249
00:09:57.925 --> 00:09:59.245
it's nice and flat in the surrounding area.

250
00:09:59.705 --> 00:10:01.045
And the area around the airport is

251
00:10:01.045 --> 00:10:02.125
not very densely populated.

252
00:10:02.425 --> 00:10:03.885
And also for an Untoured airport,

253
00:10:04.025 --> 00:10:06.125
the runway is fairly long at 8,000 feet.

254
00:10:06.475 --> 00:10:08.845
It's kind of hard to see with the, the glare of the sun,

255
00:10:09.105 --> 00:10:11.365
but the the runway is in that dashed box there.

256
00:10:12.785 --> 00:10:14.925
All right. And so we're on an ILS approach right now at a

257
00:10:14.925 --> 00:10:16.485
three nautical mile final that puts us

258
00:10:16.485 --> 00:10:17.605
at about a thousand feet.

259
00:10:17.625 --> 00:10:19.485
And we're getting guidance to the runway from that,

260
00:10:19.505 --> 00:10:20.685
uh, instrument landing system.

261
00:10:21.855 --> 00:10:24.005
Let's jump into what that looks like, uh, for the crew.

262
00:10:24.305 --> 00:10:25.925
Uh, here's two of our four display units,

263
00:10:26.305 --> 00:10:28.645
and we'll walk around this really quick for this test point.

264
00:10:28.645 --> 00:10:30.405
We've got the autopilot and auto throttle on.

265
00:10:30.905 --> 00:10:32.245
You can tell we're on an ILS approach

266
00:10:32.445 --> 00:10:33.725
'cause our lateral mode is localizer.

267
00:10:33.825 --> 00:10:35.205
Our vertical mode is glide slope.

268
00:10:36.265 --> 00:10:38.365
Our magenta flight directors giving us roll

269
00:10:38.545 --> 00:10:41.645
and flight path angle commands to track that roll, uh,

270
00:10:41.805 --> 00:10:42.845

ILS uh, data.

271
00:10:43.545 --> 00:10:45.405
And then the white flight path vector there is

272
00:10:45.405 --> 00:10:46.845
the aircraft actual trajectory.

273
00:10:47.935 --> 00:10:49.205
We're fully configured for landing

274
00:10:49.205 --> 00:10:51.565
with our flaps at three nine degrees and our gear extended.

275
00:10:52.305 --> 00:10:53.925
And then most importantly, for what we're, uh,

276
00:10:54.165 --> 00:10:55.925
focusing on today, you can tell from our cast stack

277
00:10:55.925 --> 00:10:57.125
that we do have our left engine

278
00:10:57.125 --> 00:10:58.525
intentionally shut down for this testing.

279
00:11:00.145 --> 00:11:02.045
So let's jump back out to our scenario here

280
00:11:02.045 --> 00:11:03.085
where we're a thousand feet.

281
00:11:03.745 --> 00:11:05.605
Now let's act like we have a really bad day

282
00:11:05.745 --> 00:11:07.205
and we, our hazard analysis,

283
00:11:07.385 --> 00:11:09.405
hazard analysis actually comes true

284
00:11:09.825 --> 00:11:11.845
and we have a failure of our only operating engine.

285
00:11:12.985 --> 00:11:15.245
So now as we transition to being a glider,

286
00:11:15.425 --> 00:11:16.805
our sink rate is gonna more than double

287
00:11:17.345 --> 00:11:18.765
and we're no longer gonna make the airport,

288
00:11:18.765 --> 00:11:20.405
we're not even gonna make the airport environment.

289
00:11:20.615 --> 00:11:23.085
We're probably gonna end up here in the tree line somewhere.

290
00:11:23.945 --> 00:11:26.045
Uh, with that, uh, more bad news.

291
00:11:26.235 --> 00:11:28.525
With this altitude, we don't have the time we need

292
00:11:28.525 --> 00:11:29.525
to restart the engine that we

293
00:11:29.645 --> 00:11:30.725
previously intentionally shut down.

294
00:11:31.745 --> 00:11:34.245
So, uh, in this scenario,

295
00:11:34.295 --> 00:11:36.045
we're having a definite off airport landing.

296
00:11:36.225 --> 00:11:38.565
We need about 75 seconds to get that engine restarted.

297
00:11:38.775 --> 00:11:40.525

We're gonna be making contact with the ground

298
00:11:40.545 --> 00:11:41.605
in about 30 seconds.

299
00:11:43.185 --> 00:11:44.285
So we've encountered our hazard.

300
00:11:44.315 --> 00:11:45.525
What are we gonna try to do about it?

301
00:11:45.835 --> 00:11:47.245
It's obviously gonna be a very high workload

302
00:11:47.245 --> 00:11:49.005
environment with limited time.

303
00:11:49.305 --> 00:11:50.445
So we're gonna split the task in

304
00:11:50.445 --> 00:11:51.965
between our pilot following and our pilot monitoring.

305
00:11:52.065 --> 00:11:54.525
And the top left, this is an actual excerpt, uh,

306
00:11:54.525 --> 00:11:56.365
that we have that we brief on the day of testing.

307
00:11:56.905 --> 00:11:57.925
And, uh, we divide the task

308
00:11:57.925 --> 00:12:00.005
between the pilot flying pipe monitoring at the top left.

309
00:12:00.265 --> 00:12:02.005
The pilot filing is essentially just gonna keep flying the

310
00:12:02.165 --> 00:12:04.085
airplane pitched in for an appropriate airspeed,

311
00:12:04.285 --> 00:12:06.405
pointing the aircraft for the best landing site possible,

312
00:12:06.405 --> 00:12:07.925
and configuring the airplane to land at that site.

313
00:12:08.345 --> 00:12:10.365
At the exact same time, that pilot monitoring is going

314
00:12:10.365 --> 00:12:12.645
to immediately try to restart that left engine

315
00:12:12.645 --> 00:12:13.485
that we previously tried

316
00:12:13.545 --> 00:12:15.045
or previously shut down intentionally.

317
00:12:15.825 --> 00:12:19.085
You'll see in the green box here that we provide some, uh,

318
00:12:19.735 --> 00:12:23.165
rough altitudes for about how much altitude we think we need

319
00:12:23.165 --> 00:12:25.725
to restart the engine that's represents both the worst case

320
00:12:25.925 --> 00:12:27.365
scenario and the best case scenario

321
00:12:27.365 --> 00:12:29.405
that we'll find ourselves in in our test profile.

322
00:12:29.825 --> 00:12:31.485
And that just gives the crew a rough idea

323
00:12:31.485 --> 00:12:32.805
of when they're kind of in that danger zone

324
00:12:32.805 --> 00:12:34.925

of when they're gonna have a forced off airport landing

325
00:12:34.925 --> 00:12:37.005
versus when we think they'll get the engine restarted

326
00:12:37.005 --> 00:12:38.245
and we can fly away from the event.

327
00:12:39.665 --> 00:12:41.005
The, uh, item four

328
00:12:41.005 --> 00:12:43.325
and five at the bottom, we basically come back together, uh,

329
00:12:43.325 --> 00:12:45.085
no matter what we're landing, it's just are we choosing

330
00:12:45.085 --> 00:12:46.885
to land at Brunswick under our own accords?

331
00:12:46.885 --> 00:12:49.805
We've got the engine started, or are we going

332
00:12:49.805 --> 00:12:52.925
to have a forced off airport landing at the most, uh,

333
00:12:53.625 --> 00:12:55.285
at the best site selectable?

334
00:12:59.145 --> 00:13:00.875
Alright, so TJ talked a little bit about

335
00:13:00.875 --> 00:13:02.915
what it looks like on final when we're fully configured.

336
00:13:02.975 --> 00:13:04.875
Of course, that's not this case for the entire time

337
00:13:04.875 --> 00:13:06.195
that we're exposed to the hazard.

338
00:13:06.695 --> 00:13:08.755
So first we'll talk a little bit here about our glide

339
00:13:08.755 --> 00:13:10.715
capability In the, uh,

340
00:13:10.715 --> 00:13:13.075
in the downwind we're in a clean configuration about 1700

341
00:13:13.075 --> 00:13:14.795
feet above the ground, 200 knots.

342
00:13:14.795 --> 00:13:16.995
And from that, the test team assessed that, hey,

343
00:13:16.995 --> 00:13:18.995
we did have a good glide capability to make the airport.

344
00:13:19.375 --> 00:13:22.115
But as we continue in the downwind turn base, begin

345
00:13:22.115 --> 00:13:23.595
to configure the aircraft turn final,

346
00:13:23.895 --> 00:13:25.035
become fully configured

347
00:13:25.055 --> 00:13:27.355
and slow down to approach speed, we no longer

348
00:13:27.875 --> 00:13:29.315
maintain a glide capability to the airport.

349
00:13:29.455 --> 00:13:31.555
And same, same for the, uh, for the go around.

350
00:13:32.095 --> 00:13:34.355
Now, if you look at the engine restart envelope capability,

351
00:13:34.775 --> 00:13:37.155

so as a function of where we are in the testing,

352
00:13:37.465 --> 00:13:39.075
when can we get that engine restarted?

353
00:13:39.255 --> 00:13:41.315
So if you remember, there were two specific altitudes on the

354
00:13:41.435 --> 00:13:43.035
Tisha that were important for the pilot flying

355
00:13:43.035 --> 00:13:45.035
that day from in a clean configuration,

356
00:13:45.315 --> 00:13:47.035
I need 1100 feet to get the motor started.

357
00:13:47.295 --> 00:13:48.715
If I'm in a dirty configuration,

358
00:13:48.955 --> 00:13:50.755
I need 2,500 feet to get the motor started.

359
00:13:51.135 --> 00:13:53.235
So I've got enough altitude as I, uh,

360
00:13:53.305 --> 00:13:54.435
proceed on the downwind

361
00:13:54.435 --> 00:13:56.435
and configure to a flaps ten one hundred eighty knots,

362
00:13:56.505 --> 00:13:58.675
turn the corner on base, get flaps of 20.

363
00:13:58.725 --> 00:13:59.995
Still good for the configuration,

364
00:14:00.455 --> 00:14:04.075
but once I fully configure flaps 39, slow to approach speed,

365
00:14:04.335 --> 00:14:07.155
no longer have the time to, uh, get that motor started.

366
00:14:07.905 --> 00:14:10.715
Same with the, uh, low approach and the, uh, go around.

367
00:14:11.335 --> 00:14:13.155
So a little better for the engine restart,

368
00:14:13.375 --> 00:14:14.715
but not exactly what we want.

369
00:14:14.975 --> 00:14:16.235
If we put the two of them together.

370
00:14:16.455 --> 00:14:19.715
So we've got the glide in solid airplane and the restart

371
00:14:19.715 --> 00:14:22.675
and the dashed airplane, you can see that on the downwind,

372
00:14:22.685 --> 00:14:24.435
we've got some options on the base.

373
00:14:24.575 --> 00:14:26.355
We only have the engine restart option.

374
00:14:26.535 --> 00:14:28.915
And as we turn final, we're pretty much exposed

375
00:14:28.915 --> 00:14:30.115
to the catastrophic outcome.

376
00:14:30.575 --> 00:14:33.115
And that's about 40% of the time that we're in the test

377
00:14:33.425 --> 00:14:35.595
that if we have a loss of the operating engine,

378
00:14:35.725 --> 00:14:39.035

we're gonna end up with a catastrophic outcome that equates

379
00:14:39.035 --> 00:14:41.835
to about 20 minutes of time based on the four approaches

380
00:14:41.835 --> 00:14:44.235
that we had to do in the G 700 and G 800.

381
00:14:45.985 --> 00:14:47.885
So when we got to the first safety review board

382
00:14:47.885 --> 00:14:50.925
for the G 700 and G 800, we kind of had this realization

383
00:14:50.925 --> 00:14:52.525
of the increase in risk exposure.

384
00:14:52.985 --> 00:14:54.445
So we first went back to the test team

385
00:14:54.445 --> 00:14:56.005
and said, Hey, is there something we can do

386
00:14:56.005 --> 00:14:57.125
to change our test technique?

387
00:14:57.505 --> 00:14:59.885
Is this appropriate for what's been put out in the guidance?

388
00:15:00.385 --> 00:15:01.805
And a quick review of the, uh,

389
00:15:01.805 --> 00:15:05.325
appropriate advisory circulars and, uh, our test plan

390
00:15:05.325 --> 00:15:06.925
and our cert plan realized that yeah, we were,

391
00:15:06.945 --> 00:15:08.325
we were going down the right path

392
00:15:08.945 --> 00:15:11.125
and we really felt that to remove those limitations

393
00:15:11.125 --> 00:15:13.165
that we had in our existing aircraft,

394
00:15:13.165 --> 00:15:14.045
that we were gonna need to

395
00:15:14.205 --> 00:15:15.365
demonstrate this down to sea level.

396
00:15:16.145 --> 00:15:18.245
So the SRB agreed the, uh,

397
00:15:18.245 --> 00:15:20.165
risk mitigations the team had were appropriate,

398
00:15:20.465 --> 00:15:22.765
but we gave them a challenge as we left the SRB.

399
00:15:22.785 --> 00:15:25.325
We weren't super comfortable with those 20 minutes of time

400
00:15:25.375 --> 00:15:27.325
where we were gonna have a catastrophic outcome.

401
00:15:27.665 --> 00:15:30.525
So we said, Hey, look, we've got G 800 coming in about a

402
00:15:30.525 --> 00:15:33.165
year as you guys work through the G 700 testing.

403
00:15:33.465 --> 00:15:36.485
Why don't you go back and redo your, your test approach

404
00:15:36.505 --> 00:15:37.565
and see if there's a way where

405
00:15:37.565 --> 00:15:38.725

we can make things a little bit better?

406
00:15:39.345 --> 00:15:40.345
And that's what they did.

407
00:15:44.825 --> 00:15:47.325
All right. So esto, I said, uh, we walked outta that SRB

408
00:15:47.325 --> 00:15:49.085
with an action to go brainstorm some ideas.

409
00:15:49.465 --> 00:15:50.685
Uh, we came up with several ideas

410
00:15:50.685 --> 00:15:52.165
that we thought were decent, uh,

411
00:15:52.635 --> 00:15:53.885
just assimilating the engine failure

412
00:15:53.885 --> 00:15:54.805
by having an engine idle

413
00:15:54.805 --> 00:15:55.885
instead of actually shutting it down.

414
00:15:56.375 --> 00:15:58.445
After some initial technical discussions with F FA

415
00:15:58.445 --> 00:15:59.765
that we decided not to pursue this farther

416
00:16:00.285 --> 00:16:01.845
'cause of potential issues with the system not actually

417
00:16:01.845 --> 00:16:04.285
being in a representative, uh, certification configuration

418
00:16:04.345 --> 00:16:05.485
by simulating that failure.

419
00:16:06.195 --> 00:16:07.805
Next, we considered using a long runway

420
00:16:07.805 --> 00:16:10.445
with a custom LPV approach to having aiming point,

421
00:16:10.545 --> 00:16:11.805
aiming point somewhere down the runway.

422
00:16:12.385 --> 00:16:15.045
Uh, that option just really, um, potentially shifts the risk

423
00:16:15.045 --> 00:16:17.685
to the go around phase, and it also has no impact on our

424
00:16:17.685 --> 00:16:19.085
engine restart, uh, capability.

425
00:16:20.025 --> 00:16:22.245
And then lastly, we considered using an LPV approach

426
00:16:22.245 --> 00:16:25.205
to a virtual elevated, uh, altitude airport.

427
00:16:25.505 --> 00:16:28.285
Uh, this is a basically just a fake airport that our, uh,

428
00:16:28.645 --> 00:16:30.685
Avion supplier generates in, uh,

429
00:16:30.765 --> 00:16:32.325
a custom navigation database for us

430
00:16:32.585 --> 00:16:34.445
and something that we've had experience with in the past,

431
00:16:34.865 --> 00:16:36.165
uh, for other systems testing.

432
00:16:36.705 --> 00:16:38.645

Uh, and we generally have them off in the warning

433
00:16:38.645 --> 00:16:39.925
areas off the coast of Savannah.

434
00:16:40.465 --> 00:16:42.885
Uh, this is actually the path we decided to pursue further.

435
00:16:43.185 --> 00:16:44.325
And we basically took that concept

436
00:16:44.425 --> 00:16:45.805
of having a virtual airport,

437
00:16:46.025 --> 00:16:48.445
but for the first time applied it over a real airport.

438
00:16:48.665 --> 00:16:50.725
And so that airport that we chose to utilize, uh,

439
00:16:50.725 --> 00:16:52.685
the first time we did this was Brunswick,

440
00:16:52.735 --> 00:16:54.405
which was the airport that we were looking at in the

441
00:16:54.565 --> 00:16:55.805
scenario earlier that I walked you through.

442
00:16:56.545 --> 00:16:58.045
And then for reference, uh, Brunswick is

443
00:16:58.045 --> 00:16:59.325
essentially a sea level airport.

444
00:16:59.625 --> 00:17:01.565
So all the altitudes going forward for simplicity,

445
00:17:01.565 --> 00:17:03.005
we can just think of as above ground level.

446
00:17:03.865 --> 00:17:05.325
Uh, we called that airport

447
00:17:05.325 --> 00:17:07.805
and our custom navigation database, BQK two,

448
00:17:08.265 --> 00:17:10.325
we essentially just took the Latin long of that airport

449
00:17:10.625 --> 00:17:13.085
and all the way points associated with the LPV approaches

450
00:17:13.145 --> 00:17:16.685
to those runways, and we just shifted them up 2,800 feet.

451
00:17:17.105 --> 00:17:19.805
So that results in our final approach fix going from 1700

452
00:17:19.835 --> 00:17:21.845
feet to 4,500 feet.

453
00:17:22.145 --> 00:17:25.125
And it results in our decision altitude going from 200 feet

454
00:17:25.305 --> 00:17:26.445
to 3000 feet.

455
00:17:27.505 --> 00:17:29.925
The benefits of this altitude are really pretty obvious once

456
00:17:29.925 --> 00:17:32.845
you say it out loud, but it's altitude, uh, it,

457
00:17:32.845 --> 00:17:34.285
it provides us time and distance.

458
00:17:34.285 --> 00:17:35.485
That's time to restart the engine

459
00:17:35.745 --> 00:17:38.165

and distance to glide to the actual airport.

460
00:17:39.385 --> 00:17:40.725
All right, so let's quickly look again

461
00:17:40.725 --> 00:17:42.645
and remind you of, uh, the ILS approach

462
00:17:42.645 --> 00:17:43.845
that we're on at a thousand feet

463
00:17:43.895 --> 00:17:45.085
where if we encounter a hazard,

464
00:17:45.085 --> 00:17:46.965
we're having a definite off airport landing.

465
00:17:48.025 --> 00:17:50.325
Now this is what that equivalent point in our test prof

466
00:17:50.325 --> 00:17:53.365
profile looks like when we use our updated test method

467
00:17:53.545 --> 00:17:56.205
of using our elevated altitude LPV approach.

468
00:17:57.025 --> 00:18:00.365
So now we're on a glide path, a 3G glide path

469
00:18:00.365 --> 00:18:01.965
to a virtual airport that you can't see out there,

470
00:18:01.965 --> 00:18:03.605
but it's represented for just this image

471
00:18:03.605 --> 00:18:04.925
by this uh, dash box.

472
00:18:05.755 --> 00:18:07.925
That glide path is taking you somewhere

473
00:18:07.925 --> 00:18:08.965
beyond the real airport.

474
00:18:09.425 --> 00:18:10.805
But now if we encounter our hazard,

475
00:18:11.665 --> 00:18:13.645
our glide capability's gonna let us reach the airport.

476
00:18:15.055 --> 00:18:16.705
More importantly, now

477
00:18:16.705 --> 00:18:18.625
that we're a thousand feet on our virtual approach,

478
00:18:18.935 --> 00:18:21.585
that puts us 3,800 feet above the real airport.

479
00:18:22.005 --> 00:18:24.145
So we have the time we need to restart the engine.

480
00:18:24.325 --> 00:18:25.345
So really the gliding,

481
00:18:25.345 --> 00:18:27.065
the airport is really just a backup option

482
00:18:27.205 --> 00:18:29.545
and we intend to fly away from the event if we encounter our

483
00:18:29.545 --> 00:18:30.865
hazard by restarting that engine.

484
00:18:32.245 --> 00:18:33.785
So with that updated test method,

485
00:18:33.885 --> 00:18:35.465
our hazard analysis gets updated.

486
00:18:35.925 --> 00:18:37.145

Uh, the hazard, the cause

487
00:18:37.145 --> 00:18:38.985
and the probability in white are all unchanged,

488
00:18:39.365 --> 00:18:42.065
but the effect goes from, uh, off airport landing

489
00:18:42.085 --> 00:18:43.305
to extreme clue workload.

490
00:18:43.855 --> 00:18:46.265
Obviously we had extreme cool workload in our original

491
00:18:46.425 --> 00:18:48.425
scenario, but now we get to stop that sequence

492
00:18:48.425 --> 00:18:50.865
of events there and we prevent that off airport landing

493
00:18:51.735 --> 00:18:52.945
with the effect changing.

494
00:18:53.005 --> 00:18:55.425
Our severity also changes from catastrophic to major.

495
00:18:55.925 --> 00:18:56.985
But it's worth noting here

496
00:18:57.095 --> 00:18:59.465
that we do take a conservative stance in our analysis

497
00:18:59.805 --> 00:19:01.825
and we pre, we retain those preventative actions

498
00:19:02.325 --> 00:19:03.545
and minimization and procedures

499
00:19:03.705 --> 00:19:05.905
that we employed when we assumed the catastrophic

500
00:19:06.105 --> 00:19:07.225
catastrophic effect.

501
00:19:07.445 --> 00:19:09.705
And we do that because we only have one chance to restart

502
00:19:09.705 --> 00:19:12.545
that engine and we don't have the glide option in a hundred

503
00:19:12.545 --> 00:19:13.585
percent of our test profile.

504
00:19:14.925 --> 00:19:16.345
So with that updated severity,

505
00:19:16.605 --> 00:19:18.465
we just slide down in our list ma risk matrix.

506
00:19:18.875 --> 00:19:20.185
Still consider it medium risk,

507
00:19:20.445 --> 00:19:22.425
but I think we can all agree that not all medium risk

508
00:19:22.425 --> 00:19:23.505
testing is created equal.

509
00:19:25.195 --> 00:19:27.535
So quickly review what Tobias walked you through earlier,

510
00:19:27.535 --> 00:19:30.695
where when we use our traditional test method going, uh,

511
00:19:30.755 --> 00:19:33.535
all the way down on is approach, we expose our,

512
00:19:33.705 --> 00:19:35.615
we're in a scenario during 4% of the testing

513
00:19:35.685 --> 00:19:37.455

that we can't prevent that off airport landing.

514
00:19:38.955 --> 00:19:41.215
Now this is where it looks like when we use our update test

515
00:19:41.215 --> 00:19:43.535
method with that elevated altitude LPV approach.

516
00:19:43.875 --> 00:19:46.295
Pretty apparent here, a lot less red

517
00:19:46.355 --> 00:19:48.255
and a lot more green green's, obviously good.

518
00:19:48.755 --> 00:19:51.535
And um, the glide opportunity represented

519
00:19:51.535 --> 00:19:54.095
by the solid airplane, uh, we, it's improved,

520
00:19:54.275 --> 00:19:56.215
but you can see kind of out that extended base and final.

521
00:19:56.275 --> 00:19:57.935
We still don't have the opportunity to reach the airport,

522
00:19:58.355 --> 00:19:59.775
but more importantly here, the uh,

523
00:19:59.775 --> 00:20:02.375
the dash airplane representing our restart capability is

524
00:20:02.375 --> 00:20:03.695
green throughout the whole test profile.

525
00:20:03.755 --> 00:20:05.615
And that was the intent of the altitude that we chose

526
00:20:05.875 --> 00:20:07.135
and that was the goal is to make it

527
00:20:07.135 --> 00:20:08.655
so we had the time to restart the engine.

528
00:20:08.955 --> 00:20:11.335
So essentially here we've removed our exposure to that

529
00:20:11.335 --> 00:20:12.775
as catastrophic outcome.

530
00:20:17.255 --> 00:20:19.465
Alright, so what did this look like on,

531
00:20:19.465 --> 00:20:20.585
uh, certification day?

532
00:20:20.615 --> 00:20:24.985
This is a, a video of the pilot's HUD with an EVS image up,

533
00:20:25.445 --> 00:20:28.385
uh, during a fully coupled single engine approach to that,

534
00:20:28.405 --> 00:20:29.505
uh, elevated airport.

535
00:20:29.685 --> 00:20:31.745
You can see Brunswick down there in the yellow box below.

536
00:20:31.745 --> 00:20:33.025
We're about 3000 feet above it.

537
00:20:33.445 --> 00:20:35.945
You can see that we're fully coupled with the autopilot

538
00:20:36.165 --> 00:20:37.345
and auto throttle engaged.

539
00:20:37.725 --> 00:20:42.465
Our lateral mode is FMS and we're on an LPV approach.

540
00:20:42.845 --> 00:20:44.505

And the no flare queue is just a byproduct

541
00:20:44.505 --> 00:20:46.905
of a higher altitude in the ride ALT being invalid.

542
00:20:49.865 --> 00:20:51.285
So as we reach minimums,

543
00:20:51.285 --> 00:20:53.565
we transition from the approach mode to the go around mode

544
00:20:53.625 --> 00:20:55.645
as indicated in the FMAs up at the top.

545
00:21:01.535 --> 00:21:03.475
And in this situation it's a, uh,

546
00:21:03.625 --> 00:21:06.035
it's a rather benign flight test video, which is kind

547
00:21:06.035 --> 00:21:07.075
of exactly what you're looking

548
00:21:07.095 --> 00:21:09.555
for when you're doing certification testing on your A FCS.

549
00:21:10.935 --> 00:21:13.395
Uh, of note, when we got to the debrief on this,

550
00:21:13.655 --> 00:21:16.675
the FAA had in been involved in both the company

551
00:21:17.335 --> 00:21:19.555
and the, uh, certification testing with us.

552
00:21:19.695 --> 00:21:21.915
And a comment from the FAA pilot who's actually in the room

553
00:21:21.915 --> 00:21:23.435
here today was that uh,

554
00:21:24.465 --> 00:21:27.235
this new test method was much better for him

555
00:21:27.355 --> 00:21:28.475
'cause it gave him a lot more time

556
00:21:28.735 --> 00:21:30.275
to focus on the system under test

557
00:21:30.575 --> 00:21:33.315
and not kind of evaluating that system while looking

558
00:21:33.615 --> 00:21:35.395
for a place to land should we have a

559
00:21:35.395 --> 00:21:36.475
failure of the operating engine.

560
00:21:36.655 --> 00:21:38.435
So it gave him a lot more time to really kind

561
00:21:38.435 --> 00:21:39.795
of evaluate the system under test.

562
00:21:41.615 --> 00:21:43.035
All right, so where do we go from here?

563
00:21:43.375 --> 00:21:45.795
So lessons learned kind of for the test team during the, uh,

564
00:21:46.015 --> 00:21:48.475
the G 800 program when we implemented the new test

565
00:21:48.715 --> 00:21:50.515
technique, we're pretty much technical in nature.

566
00:21:50.615 --> 00:21:52.515
You can see that we had a few artifacts in the HUD

567
00:21:52.695 --> 00:21:54.675

and some synthetic vision issues

568
00:21:54.905 --> 00:21:56.075
with the change in altitude,

569
00:21:56.255 --> 00:21:59.115
but none of those were related to to to safety,

570
00:21:59.455 --> 00:22:02.035
nor did none of them prevent uh, any compliance findings.

571
00:22:02.615 --> 00:22:04.635
As we go forward with this and we implement this new test

572
00:22:04.835 --> 00:22:06.835
technique on different programs, uh, some

573
00:22:06.835 --> 00:22:09.315
of the things we're considering are increasing the altitude.

574
00:22:09.415 --> 00:22:11.795
So increasing that virtual airport altitude

575
00:22:11.795 --> 00:22:15.075
to give us more time to perhaps perhaps retain a glide

576
00:22:15.075 --> 00:22:17.075
capability at all situations

577
00:22:17.455 --> 00:22:20.035
and maybe more opportunity to get the engine started.

578
00:22:20.995 --> 00:22:23.435
Additionally, when we adopted this, we only had enough time

579
00:22:23.435 --> 00:22:26.115
to really get a virtual approach made at one airport down in

580
00:22:26.115 --> 00:22:28.915
Brunswick, which provided some operational constraints

581
00:22:28.915 --> 00:22:30.515
during certification testing.

582
00:22:30.575 --> 00:22:31.955
We only had one airport to go to

583
00:22:31.955 --> 00:22:32.955
and the weather had to be good.

584
00:22:33.295 --> 00:22:35.915
So going forward we'll probably make virtual airports

585
00:22:36.275 --> 00:22:39.155
overlaid at multiple design uh, destinations.

586
00:22:39.415 --> 00:22:41.395
So just give us that little more increased flexibility,

587
00:22:41.585 --> 00:22:43.915
operational flexibility during certification testing

588
00:22:44.895 --> 00:22:46.355
for future cert proposals.

589
00:22:46.355 --> 00:22:47.795
We were lucky for the G 800 program.

590
00:22:48.175 --> 00:22:51.515
We had just finished the 700 program uh, the year prior.

591
00:22:52.015 --> 00:22:55.155
The FAA was very familiar with the A FCS as.

592
00:22:55.155 --> 00:22:59.155
It's the same on the 700 800 that allowed us to move all

593
00:22:59.155 --> 00:23:00.755
of the testing into the virtual environment

594
00:23:00.935 --> 00:23:03.915

and not really test that worst case scenario in the G 800.

595
00:23:04.415 --> 00:23:06.875
If we have a new system with a little less system maturity

596
00:23:07.055 --> 00:23:10.235
and perhaps not as much familiarity with the FAA,

597
00:23:10.415 --> 00:23:12.675
we anticipate we might have to do a worst case scenario

598
00:23:12.675 --> 00:23:15.595
where we at least conduct one approach down to the C level

599
00:23:15.815 --> 00:23:17.915
to really tax the system at the uh,

600
00:23:18.655 --> 00:23:19.755
at the hardest combination

601
00:23:19.975 --> 00:23:22.475
and maybe just do a subset of them up at altitude.

602
00:23:23.415 --> 00:23:25.435
So takeaways for you guys that are sitting here today,

603
00:23:25.815 --> 00:23:27.715
you know, adopt this idea if it makes sense to you.

604
00:23:27.855 --> 00:23:29.955
If you're doing testing in a low altitude environment,

605
00:23:30.235 --> 00:23:31.395
terminal environment on approaches

606
00:23:31.615 --> 00:23:34.355
and you don't like your risk exposure down there, hey go

607
00:23:34.355 --> 00:23:35.555
to your avionic supplier

608
00:23:35.735 --> 00:23:37.795
and have them create a virtual GPS approach

609
00:23:37.815 --> 00:23:39.795
for you either overlaid top of that airport

610
00:23:40.055 --> 00:23:41.075
or perhaps somewhere else

611
00:23:41.235 --> 00:23:43.115
that's even away from the terminal environment

612
00:23:43.125 --> 00:23:44.755
where you can meet your test objectives.

613
00:23:45.225 --> 00:23:47.125
And if you're a member of A SRB

614
00:23:47.425 --> 00:23:50.285
and you're looking at a a risk assessment from a team

615
00:23:50.285 --> 00:23:52.365
that perhaps has changed 'cause the scope has changed

616
00:23:52.905 --> 00:23:54.605
and you're not a hundred percent comfortable

617
00:23:54.605 --> 00:23:57.245
with what's going on, then make a challenge to that team

618
00:23:57.245 --> 00:23:58.285
to come up with something different.

619
00:23:58.465 --> 00:24:00.485
In this case, we had two pretty tight timelines

620
00:24:00.785 --> 00:24:02.685
and we uh, had a discussion with the test team

621
00:24:02.865 --> 00:24:05.125

and they were able to come up with a really good solution

622
00:24:05.235 --> 00:24:06.725
that allowed us to reduce our risk

623
00:24:06.965 --> 00:24:08.245
exposure on the following program.

624
00:24:11.785 --> 00:24:13.165
And that's what we got. And I'd like

625
00:24:13.165 --> 00:24:14.605
to open up the floor for questions at this time.

626
00:24:24.495 --> 00:24:24.715
Uh,

627
00:24:30.635 --> 00:24:31.635
Yeah, I think so.

628
00:24:31.935 --> 00:24:34.455
I dunno if this is elevating my voice or not.

629
00:24:34.455 --> 00:24:36.095
I'll talk loud. I don't think it's working. But

630
00:24:36.285 --> 00:24:37.285
Wait a second.

631
00:24:37.315 --> 00:24:39.655
For the constructed database,

632
00:24:39.675 --> 00:24:41.695
did you ever consider there's another set

633
00:24:41.695 --> 00:24:44.855
of knob in the system that's got an antenna offset

634
00:24:44.855 --> 00:24:47.775
that compensates for the height of where on your

635
00:24:47.875 --> 00:24:50.155
and your CPS that is located.

636
00:24:50.815 --> 00:24:52.315
If you could dial that kn

637
00:24:52.335 --> 00:24:56.075
to having your antenna simulated 1500 people below you,

638
00:24:56.895 --> 00:24:58.425
that could have saved a lot of, you know,

639
00:24:58.665 --> 00:25:00.345
database construction that could be portable tool

640
00:25:00.365 --> 00:25:02.465
you could use elsewhere. Look into that at

641
00:25:02.465 --> 00:25:03.465
All. And were there

642
00:25:03.465 --> 00:25:04.545
thoughts

643
00:25:04.545 --> 00:25:06.345
or challenges with your system for that? Oh,

644
00:25:06.395 --> 00:25:07.395
Hello. Uh, no,

645
00:25:07.395 --> 00:25:08.745
honestly I wasn't uh, familiar with that,

646
00:25:08.765 --> 00:25:09.985
uh, capability.

647
00:25:10.205 --> 00:25:11.705
Uh, so we did not look into that at all.

648
00:25:11.765 --> 00:25:14.305

We, we kinda just took that past experience we had

649
00:25:14.305 --> 00:25:15.305
with using it for other testing

650
00:25:15.365 --> 00:25:16.785
and we just applied that, what we already

651
00:25:16.785 --> 00:25:17.825
knew to this testing.

652
00:25:18.015 --> 00:25:20.145
Sure, I'll go look into that though.

653
00:25:23.035 --> 00:25:24.625
Thank you for the presentation.

654
00:25:24.925 --> 00:25:29.385
Um, um, one question I have is, you said that you, part

655
00:25:29.385 --> 00:25:32.105
of the mitigations is to monitor bird activity.

656
00:25:32.405 --> 00:25:35.465
Um, I'm just curious of, uh, about how how you did that.

657
00:25:36.135 --> 00:25:39.345
Yeah, so, uh, at the brief, uh, on test day, uh,

658
00:25:39.345 --> 00:25:41.545
we look up, uh, I think it's called the A HAS, uh,

659
00:25:41.545 --> 00:25:43.985
which is just an online database run

660
00:25:43.985 --> 00:25:45.985
by some military organization I believe.

661
00:25:46.405 --> 00:25:49.625
Um, and it gives you a, a rating, uh,

662
00:25:49.785 --> 00:25:50.825
a low, moderate or high.

663
00:25:51.205 --> 00:25:52.505
And uh, if it goes in above

664
00:25:52.665 --> 00:25:53.825
moderate, I think we say we won't test.

665
00:25:54.165 --> 00:25:57.585
And we also recently implemented um, that uh, we tend

666
00:25:57.585 --> 00:25:59.105
to do a kind of a warmup approach

667
00:25:59.105 --> 00:26:01.465
with the engine in a simulated, uh, idle condition

668
00:26:01.615 --> 00:26:03.825
that gives us time to cool down the engine, kind

669
00:26:03.825 --> 00:26:05.465
of let the crew warm up and let's just kind

670
00:26:05.465 --> 00:26:07.065
of evaluate the bird activity in that sense.

671
00:26:07.065 --> 00:26:09.025
Obviously, uh, every approach

672
00:26:09.025 --> 00:26:10.105
to approach is gonna be different

673
00:26:10.105 --> 00:26:11.425
and it's a little subjective for the crew

674
00:26:11.425 --> 00:26:12.825
to kind of call out what they're seeing.

675
00:26:13.325 --> 00:26:15.345

Um, but we, we kinda have that buildup approach

676
00:26:15.605 --> 00:26:16.985
and uh, that database to look at.

677
00:26:16.985 --> 00:26:17.985
There's the only two things,

678
00:26:20.565 --> 00:26:21.985
Um, I'm wondering with,

679
00:26:22.135 --> 00:26:24.945
with tightly integrated systems like these over here.

680
00:26:25.925 --> 00:26:29.185
Um, if so you,

681
00:26:29.485 --> 00:26:31.305
you know you mentioned the radar altimeter.

682
00:26:31.725 --> 00:26:35.705
Um, it might be different on ILS, right?

683
00:26:35.705 --> 00:26:37.425
You, you already mentioned it might be different if the

684
00:26:37.425 --> 00:26:40.025
engine was idling and not fully shut down

685
00:26:40.025 --> 00:26:41.105
because of system state.

686
00:26:41.325 --> 00:26:44.885
And I'm just wondering if you did systems analysis at all

687
00:26:44.995 --> 00:26:47.765
that said that all of the differences

688
00:26:47.835 --> 00:26:50.205
that could have been right is the radar altimeter fully

689
00:26:50.315 --> 00:26:53.365
independent of that system, et cetera, et cetera.

690
00:26:53.365 --> 00:26:56.285
All the differences that could be at a system level

691
00:26:56.315 --> 00:26:59.405
with an integrated system are not affected. Yeah,

692
00:26:59.405 --> 00:27:00.605
That was actually a big piece

693
00:27:00.605 --> 00:27:03.085
of this project was convincing ourselves that

694
00:27:03.145 --> 00:27:05.325
by gonna this higher altitude, one of the main things was

695
00:27:05.325 --> 00:27:07.485
that the radar were outside the realm of where

696
00:27:07.485 --> 00:27:08.725
that provides the system's data

697
00:27:09.105 --> 00:27:10.365
and how that affects the system.

698
00:27:10.785 --> 00:27:12.965
And at a whole, we really identified

699
00:27:12.965 --> 00:27:14.365
that it degrades the system a little bit

700
00:27:14.665 --> 00:27:17.125
and so we were being a little conservative there by taking

701
00:27:17.125 --> 00:27:18.405
that information away from the system.

702
00:27:18.945 --> 00:27:22.485

Uh, had to by other means, um, um,

703
00:27:22.635 --> 00:27:24.205
determine where it is basically.

704
00:27:24.625 --> 00:27:26.085
And so, uh, we did look into that.

705
00:27:26.085 --> 00:27:27.605
That was a big piece of that, this project.

706
00:27:27.665 --> 00:27:29.085
But we left that outta the presentation just

707
00:27:29.245 --> 00:27:30.565
'cause it was kind of technical in nature

708
00:27:30.565 --> 00:27:31.565
and not really safety related,

709
00:27:31.665 --> 00:27:33.685
but uh, it was a huge part of this project.

710
00:27:34.925 --> 00:27:38.155
I answer your question appropriately, we can talk after

711
00:27:44.085 --> 00:27:45.375
Just a follow up to Nome.

712
00:27:45.915 --> 00:27:49.455
So did you use STPA for that complex system analysis?

713
00:27:51.395 --> 00:27:52.375
Uh, no sir,

714
00:27:55.235 --> 00:27:56.415
But we'll look at it going forward.

715
00:28:00.685 --> 00:28:02.055
Okay. Alright. Thanks guys. Thanks guys.